

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>1415.P002PCT</b>	<b>FOR FURTHER ACTION</b>	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPRA/416).
International Application No. <b>PCT/SG2003/000296</b>	International Filing Date (day/month/year) <b>30 December 2003</b>	Priority Date (day/month/year) <b>30 December 2003</b>
International Patent Classification (IPC) or national classification and IPC <b>Int. Cl. <sup>7</sup> H05B 33/00</b>		
Applicant <b>AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH et al</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of **3** sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of **6** sheet(s).

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand <b>22 December 2004</b>	Date of completion of the report <b>2 August 2005</b>
Name and mailing address of the IPRA/AU <b>AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929</b>	Authorized Officer  <b>LARS KOCH Telephone No. (02) 6283 2551</b>

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.:

PCT/SG2003/000296

## I. Basis of the report

1. With regard to the elements of the international application:\*

☐ the international application as originally filed.

☒ the description, pages 1-10, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of

☒ the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages 11-16, received on 18 July 2005 with the letter of 18 July 2005

☒ the drawings, pages 1/2-2/2, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of

☐ the sequence listing part of the description:

pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SG2003/000296

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Claims 1-29	YES
	Claims -	NO
Inventive step (IS)	Claims 1-29	YES
	Claims -	NO
Industrial applicability (IA)	Claims 1-29	YES
	Claims -	NO

### 2 Citations and explanations (Rule 70.7)

The following documents identified in the International Search Report have been considered for the purposes of this report:

D1 US 2002/0022156 A1 (BRIGHT) 21 February 2002  
D2 US 2003/0178937 A1 (MISHIMA) 25 September 2003

#### Novelty (N)

Claims 1-29 meet the criteria set forth in PCT Article 33(2) for novelty. The prior art published before the priority date does not disclose a metal electrode having an interfacial modified surface for enhancing charge carrier injection.

#### Inventive Step (IS)

Claims 1-29 meet the criteria set out in PCT Article 33(3) with regard to the requirement of Inventive Step because the prior art does not obviously suggest to a person skilled in the art a metal electrode having an interfacial modified surface for enhancing charge carrier injection.

#### Industrial Applicability (IA)

The invention defined in the claims is considered to meet the requirements of Industrial Applicability under Article 33(4) of the PCT because it can be made by, or used in, industry.

**CLAIMS**

1. A flexible organic light emitting device comprising:

a flexible substrate,

a lower electrode layer on said flexible substrate,

an upper electrode layer that is at least semi-transparent,

an organic region between said lower electrode layer and said upper electrode layer, in which electroluminescence can take place when a voltage is applied between said lower electrode layer and said upper electrode layer,

wherein said flexible substrate is comprised of one of the following:

(i) a plastic layer laminated to or coated with a metal layer, (ii) a metal layer sandwiched between two plastic layers, and (iii) a metal foil;

further wherein at least one of the lower electrode layer and the upper electrode layer is a metal electrode having an interfacial modified surface for enhancing charge carrier injection wherein said interfacial modified surface is between said organic region and said metal electrode.

2. The flexible organic light emitting device of claim 1, wherein said interfacial modified surface may be formed by modifying said metal electrode using a TCO.

3. The flexible organic light emitting device of claim 1, wherein said interfacial modified surface may be formed by modifying said metal electrode using inorganic or organic materials

4. The flexible organic light emitting device of claim 1, wherein said flexible substrate is comprised of a plastic layer laminated to or coated with an aluminum layer, the plastic layer being positioned between the lower electrode layer and the aluminum layer.
5. The flexible organic light emitting device of claim 1, wherein said flexible substrate is comprised of a steel foil.
6. The flexible organic light emitting device of claim 1 further comprising an isolation layer between said flexible substrate and said lower electrode layer.
7. The flexible organic light emitting device of claim 6, wherein said isolation layer is a spin-coated polymeric layer or a dielectric layer.
8. The flexible organic light emitting device of claim 5 further comprising an isolation layer between said steel foil and said lower electrode layer.
9. The flexible organic light emitting device of claim 1, wherein said upper electrode layer is transparent.
10. The flexible organic light emitting device of claim 1, wherein said upper electrode layer is a semitransparent or transparent anode.

11. The flexible organic light emitting device of claim 1, wherein said upper electrode layer is a semitransparent or transparent cathode.

12. The flexible organic light emitting device of claim 1, wherein said upper electrode layer is a multilayer structure comprising at least one semitransparent or transparent conductive film.

13. The flexible organic light emitting device of claim 12, wherein said multilayer structure comprises an index-matching layer and a charge carrier injection layer.

14. The flexible organic light emitting device of claim 13, wherein said index-matching layer comprises an organic material having a refractive index effective for enhancing light output.

15. The flexible organic light emitting device of claim 13, wherein said index-matching layer comprises an inorganic material having a refractive index effective for enhancing light output.

16. The flexible organic light emitting device of claim 13, wherein said multilayer structure is an anode and said charge carrier injection layer is a hole injection layer.

17. The flexible organic light emitting device of claim 16, wherein said hole injection layer comprises a high work function metal or a transparent conductive oxide (TCO).

18. The flexible organic light emitting device of claim 17, wherein said high work function metal is gold or silver.

19. The flexible organic light emitting device of claim 17, wherein said TCO is metal oxide.

20. The flexible organic light emitting device of claim 17, wherein said TCO is selected from the group consisting of indium-tin-oxide (ITO), zinc-indium-oxide, aluminum-doped zinc oxide, Ga-In-Sn-O,  $\text{SnO}_2$ , Zn-In-Sn-O, and Ga-In-O.

21. The flexible organic light emitting device of claim 16, wherein said hole injection layer comprises an organic material effective for hole injection or a combination of inorganic and organic materials that are effective for hole injection.

22. The flexible organic light emitting device of claim 16, wherein said hole injection layer comprises an inorganic material effective for hole injection or a combination of inorganic and organic materials that are effective for hole injection.

23. The flexible organic light emitting device of claim 11, wherein said multilayer

structure is a cathode and said charge carrier injection layer is an electron injection layer.

24. The flexible organic light emitting device of claim 21, wherein said electron injection layer comprises a low work function metal.

25. The flexible organic light emitting device of claim 22, wherein said low work function metal is a rare earth metal.

26. The flexible organic light emitting device of claim 21, wherein said index-matching layer comprises tris-(8-hydroxyquinoline) aluminum (Alq3) or N,N'-di(naphthalene-1-yl)-N,N'-diphenylbenzidine (NPB).

27. The flexible organic light emitting device of claim 21, wherein said cathode comprises a silver layer and said electron injection layer is comprised of a calcium sub-layer over a lithium fluoride sub-layer, the silver layer being formed over the calcium layer.

28. The flexible organic light emitting device of claim 1, wherein said organic region comprises (i) a hole transporting layer and (ii) an emissive layer or an electron transporting layer.



29. The flexible-organic light emitting device of claim 1, wherein said organic region comprises (i) a hole transporting layer, (ii) an emissive layer, and (iii) an electron transporting layer.